Improving the sustainability of agriculture

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Introduction

Humans invented agriculture years ago, in ancient times, when farming was nowhere near as large scale as it is today. For a long time, humans only grew the amount of food that they needed and ate all the parts of the plants they grew and livestock they raised. This was all true until recently. Prior to the Green Revolution, which started around the time of the end of World War 2, agriculture was not as large of a sector as it is today ("Timeline of agriculture"). With new technologies, and methods of farming developing, the productivity of agriculture, increased during the Green Revolution, and after it. What also increased as the processing of foods and the chemicals such as pesticides and fertilizers which were used. Despite technological advances, there was also a growing population which accounted for a need to grow more food, to keep up with the amount of food that was needed. It was not until post 2nd world war, that the amount of food grown became of greater importance than food quality and food production. Governments and businesses started to focus less on what was good for the environment or for their people, and focused more on producing, and exporting foods, without any knowledge of what their practices would cause in the future. Some practices that existed in the 1910s, such as the Haber-Bosh process to create ammonia, still exist today, despite our perspective on the environment and its resources changing largely. The agricultural practices that we are using are causing problems such as deforestation, overfishing, decreased biodiversity, greenhouse gas emissions, food waste, soil degradation, and ocean acidification. These issues can however be solved through the implementation of sustainable agriculture.

Sustainable agriculture is defined as the ability to meet society's present food and agricultural resource needs without inhibiting future generations to meet their own needs ("What is Sustainable"). The premise of sustainable agriculture is that there is minimal environmental damage caused throughout the creation process of food, as well as minimal food waste when food is distributed (Roos). With sustainable agriculture, no chemical substances such as pesticides are used

or applied (Roos). If sustainable agriculture was fully implemented, it would mean that we would be following natural processes to grow our food, without any human involvement.

Definition of Key Terms

Agriculture

The practice and process of cultivating the soil, growing crops, and raising livestock for the purpose of providing a population with food ("Agriculture").

Climate Change

The change in the world's weather patterns, especially due to the fact that the planet is heating up ("Climate Change"). Climate change can be caused by human activities such as releasing too many greenhouse gases, as well as other things like the earth's natural cycles.

Cultivation

The act of planting, improving the growth, or helping to grow crops or any type of plants. This practice has been used for centuries and is still used today ("Cultivation Definition").

Domestication

The process of human beings taking plants or animals under control in order to provide food, money, company, or other resources ("Domestication Definition").

Exporter

A business, or country which sells goods or services to places outside of itself, to other countries ("Exporter").

Global Warming

An increase in the earth's temperatures due to greenhouse gases that are being released into the atmosphere by human activities ("Global Warming"). Global warming is a part of climate change.

Irrigation

The act of watering land in a controlled artificial way in order to grow plants or crops ("Irrigation").

Pesticides

Chemical agents used to destroy small and potentially harmful organisms that live on plants ("Pesticide")

Producer

A business or country which creates goods, most often industrialized goods, which are created or grown in large amounts. Countries that are large producers are often also exporters of the goods they grow/create ("Producer").

Soil Degradation

The decline of the state of the soil to the point where there is soil biodiversity, and soil fertility loss (Maximillian and Matthias). Soil degradation is caused by human agricultural practices.

Sustainability

The practice of taking care of the earth and its resources in such a way that the earth can support both the present and future generations equally ("Sustainability").

General Overview

Animal raising

We have been eating meat since prehistoric times when our caveman ancestors used to hunt animals, and gather berries. This diet of meat continued until the present day when over 86% of people globally consume meat on a weekly basis ("What percentage"). Meat is not the inherent issue itself however, it is the resources needed to raise livestock that causes animal raising to be unsustainable in the way that 99% of all meat is produced, in factory farms ("Animals Killed"). To raise an animal from being born to be fully grown requires a lot of food, water, and land. Animals are living beings, and therefore in order to grow, they need calories, similarly to humans. These calories mainly come from grains, where the total amount of livestock in, for example, the USA, consumes 5 times more grains than the entire human population of the country ("U.S. could"). So many of the

food we grow is given to animals, but despite this, less than 12% of our caloric intake ("U.S. could"). Furthermore, more than 50% of all antibiotics produced are given to livestock ("Animals Killed").

Raising animals does not only take a lot of food, but it also takes a lot of land area. Over 71% of the land in the European continent is used for raising animals. This accounts for land that is used to grow animal feed, land that animals graze on, and animal factory farmland ("71 per cent"). With this much land needed to raise animals, issues such as deforestation arise. There have been thousands of acres of the Amazon rainforest cut down for raising cattle ("71 per cent"). Other examples of deforestation due to animal agriculture are mostly in Central and South America, such as in Brazil, where cattle is grown for the majority of the South American continent.

Specifically for raising cattle, as well as larger animals like pigs, sheep, and lambs, there are large amounts of greenhouse gases that are produced by not only the raising of the animal but also the transportation of the products that are created out of its meat (the environmental impacts of shipping food can be seen in a section below). Cattle produce methane emissions primarily from belching, which gets into the atmosphere. Methane is one of the greenhouse gases, which is a cause of climate change and global warming. Once again, however, the issue is not with the raising of cattle, it is with the number of cattle that we are globally raising, which adds up to more than 99,790,321,400 kilograms of methane released by cattle annually (Jones).

Overfishing

Overfishing is one of the most significant contributors to decline of ocean species populations and diversity. Many millions of people rely on fish as their main source of protein ("What is Overfishing?"). Those involved in the fishing industry rely on fish as their source of income ("What is Overfishing?"). Overfishing presents itself as an issue due to the large reliance that we, as human beings have on fish ("What is Overfishing?"). However, the issue is not with fishing, but rather with the rate of fishing, which is higher than the rate of species replenishment, otherwise known as overfishing ("What is Overfishing?"). Overfishing brings issues such as the risk of extinction for particular marine life species, such as sharks and manta rays, which are illegally caught for particular body parts like fins. Due to some species already having been caught to the point of extinction, the food chain has been distributed and will continue to be. Therefore, there is and will continue to be a decreased security in the fish industry, generating economic struggles in the future ("What is Overfishing?"). Bycatch is another issue that fishing brings with it, which causes species extinction ("What is Overfishing?"). Unwanted ocean species are often caught when fishing and are not returned to the ocean in time to survive. Bycatch threatens species like marine turtles, which get

stuck in fishing nets. Millions of ocean species are impacted by ocean species, including the smallest, like coral, which is already starting to die off.

Soil degradation

One of the main concerns with our modern-day agriculture is soil degradation. Soil degradation occurs when land is not treated properly, or any other words, chemical fertilizers, and pesticides are used, or when monoculture occurs (Maximillian and Matthias). Monoculture is when the same type of crop is planted on the same plot of land repeatedly, without there being any tending to the land between the harvesting and replantation of the crop. Intensive planting of crops, similar to monoculture, leads to soil degradation as well (Maximillian and Matthias). When there are high rates of productivity needed from depleted soil, one must use chemical fertilizers to quicken the process of soil regeneration. These fertilizers can run off into the water supplies, making water in these areas toxic. Soil degradation “contributes to about 56 million tons of land depletion every year” causing freshwater and food shortages in areas where this depletion occurs (Maximillian and Matthias). Large amounts of soil degradation can have future implications on soil fertility, meaning that something has to change. Soil is an element we need to grow food, and without it, there is no life on planet earth. The way that the soil is currently being treated is not sustainable and could lead to food shortages in the future if not changed (Maximillian and Matthias).

Food shipment

Food has been traded throughout the world ever since the middle ages where for example Spices from India were traded with fruits and vegetables from Europe. Today, we ship about 90% of all food produced overseas to other countries, where the food is then consumed (Cargo). This is due to the cost of shipping being so low that companies can easily afford it. The price of shipment is what causes immense exportation and importation of goods. For example, fish being caught in Scotland is exported to Spain, and then the same type of fish is imported from Norway into Scotland. These ‘unnecessary’ shipments of foods occur all over the world. Simply because consumers want to have summer fruits during winter time or the opposite way around, is another reason for the shipping of food. This shipping does have its consequences. With boats constantly traveling back and forth between trading countries, there are greenhouse gases are emitted from the ships’ engines, which can cause ocean acidification as well as other environmental consequences ("What Is The Environmental"). Sound pollution also occurs, which can disturb the ability of marine life to navigate, at times causing the loss of this marine life ("What Is The Environmental"). On top of all of this, about 28% of all food produced is thrown away ("Food is lost"). The issue of food shipment is

not particularly to do with the sustainability of agriculture, but is still worth mentioning, as it has a large environmental impact.

Timeline of Key Events

Agriculture has existed since prehistoric times, and therefore there are many important events that can be mentioned when it comes to sustainable agriculture. The timeline below covers some of the most important technological and agricultural advancements for the issue at hand, which may be of interest ("Agriculture Timeline") ("Timeline of agriculture") ("British Agricultural").

Date	Event
~10000 BCE	Agriculture first begins in the Middle East
~9000 BCE	First cultivation of any type of plant (wild cereals), as well as raising first animal (Wild Sheep)
~7000 BCE	First domestication of animals (goats) and plants (wheat)
~6000 BCE	First irrigation system created
~5500 BCE	First food storage is built in Mehrgarh
~5000 BCE	Organized farming first begins in Egypt
~2600 BCE	First large-scale commercial timbering in Lebanon
691 BCE	First aqueduct constructed to bring water to Nineveh
500 BCE	Row cultivation of crops is first used in China
200	The fishing reel is invented in China, which is the first larger-scale fishing device
1500-1650	Dutch agricultural revolution which brings many new inventions with it, and raises production rate by 80% per farmer
1670-1770	British agricultural revolution
1809	Nicolaas Appert invents the method of canning food for preservation
1871	Pasteurization of food is invented by Louis Pasteur
1895	Refrigeration of food is introduced into the USA and the UK commercially
1913	The Haber-Bosch process is introduced to create large amounts of the fertilizer ammonia

1944	The Green Revolution begins in Mexico
1945	The UN Food and Agriculture Organization is created
1971	The 'Plant-Based' movement begins
2000	Genetically modified plants are introduced globally
1st January 2016	The Zero Hunger SDG was created by the UN

Major Parties Involved

United States of America (USA)

The USA is the world's largest exporter of food, being the world's largest producer of corn, and the third largest producer of wheat (Bajpai). Agriculture in the USA is highly dependent on machines, which makes it one of the top producers in the industry, despite under 1% of the US's population being employed in agriculture (Bajpai). Examples that the USA uses in their agricultural sector are robots, temperature sensors, moisture sensors, and GPS technology, all helping to ensure that crops are growing correctly ("Agriculture Technology"). The USA takes a quantity-over-quality approach to agriculture, meaning that the products they produce are often sprayed with pesticides, and have large environmental impacts on the fields and atmosphere they are grown in. The US takes pride in having large production and low prices, often causing damage to the environment ("Agriculture Technology").

India

India, like the USA, is a global producer and exporter of various food products, such as sugarcane, rice, and wheat (Bajpai). Despite the agricultural sector of India decreasing over the past 20 years, it still remains a largely important sector for the country's economy (Bajpai). The agricultural sector contributes about 18% to India's GDP, providing employment to over 45% of the country's population (Bajpai). Since 1980, the technology used in India's agriculture has largely advanced, bringing more resources and greater productivity of plant growth (Bajpai). Due to greater productivity of plant growth, India has been able to decrease poverty rates ("Sustainable Agriculture"). However, this same agricultural productivity means India faces deforestation, as they are continuously cutting down forests to make space for farmland ("Sustainable Agriculture"). As agriculture in India is not very sustainable, despite being of high production, India is very near to facing a groundwater crisis, as 80% of all groundwater in the country is used for growing crops

("Sustainable Agriculture"). This could lead to water shortages all over the country if the issue is not addressed ("Sustainable Agriculture").

The Netherlands

Despite being quite a small country, the Netherlands is the 2nd largest exporter of agricultural products in the world (Whiting). It is almost entirely self-sufficient in food and is a leader in efficient and sustainable agriculture (Whiting). Due to the small land size of the Netherlands, and its large population of over 18 million, the Netherlands uses the land it has as effectively as possible. Annually, vegetables, fruits, meat, flowers, and dairy products exported from the Netherlands bring in more than 65 billion euros ("Agriculture and horticulture"). The Netherlands is exemplary in sustainable agriculture in the regulations it sets for its farmers and food producers ("Agriculture and horticulture"). The government works with entrepreneurs to carry out multifunctional agriculture, a sustainable practice ("Agriculture and horticulture"). The Netherlands also has a large number of organic farms, which do not use pesticides ("Agriculture and horticulture"). The Netherlands largely invests in creating new technologies for sustainable agriculture which have led to inventions like stacked farming. The Netherlands is very invested in the issue at hand and is willing to make further steps to make their agriculture even more sustainable.

France

Among all European countries, France is the most sustainable food producer. But it has not always been this way (Win). Only recently, has France been able to pave its way to become a sustainable food producer (Win). It has achieved this through many new measures tackling food waste, creating eco-friendly farming practices, and promoting healthy food consumption to its inhabitants (Win). France ranked 1st on the Food Sustainability Index in 2017 and 2018, showing that all of the hard work the country had to improve the sustainability of its agricultural sector paid off (Win). France has the smallest amount of food waste per person in Europe, 67.2 kg, which is 20 kg less per person than Belgium for example (Win). Despite all of these achievements, there have been minimal effects on social, and economic conditions (Win). France has come up with many technological developments in the past 10 years which have allowed for the expansion of production, making France almost entirely agriculturally self-sufficient (Win).

Possible Solutions

The most urgent issues in agriculture today are the shipping of food, food waste, overfishing, and animal raising. The UN and its member nations should address these issues, which can be achieved in a variety of ways. Many member states already have regulations and technological advancements regarding agriculture, which can be adapted to an international context. In general, any regulations or policies that could reduce greenhouse gas emissions, reduce deforestation, and restore biodiversity in the ocean and on land, would be helpful towards stepping further in creating sustainable agriculture worldwide. However, there are specific, achievable steps, mentioned below, that we can implement in order to achieve these environmental goals.

A variety of regulations can be implemented in order to solve the current issue that the world faces with agriculture and its contribution to climate change. An example of a regulation that can be put into place is banning harmful pesticides. The pesticides that are sprayed onto plants are often carried through the wind or through the water when it rains, which causes various environmental impacts mentioned in the General Overview. This is the same for fertilizers, so a similar regulation can be applied to them, for example minimizing the number of fertilizers that can be used on one field, or suggesting a switch to solid fertilizers, in the position of liquid fertilizers, which leak into the water.

As mentioned, an issue with our modern agriculture is the shipping of food, so minimizing the amount of food that countries can export would help in solving the issue at hand. Many countries import the same foods as they export, so putting restrictions and regulations on “unnecessary” imports could help in reducing CO2 emissions from the agricultural sector. Another way of minimizing the shipment of foods would be promoting locally grown foods, which can be done in a variety of ways. Going back to locally grown foods would once again be an aid in reducing greenhouse gas emissions.

In order to solve the issue of animal farming and overfishing, there are various things that can be implemented. To start, promoting predominantly plant-based diets, which would reduce the meat and fish intake of consumers, would be beneficial. Additionally, minimizing the amount of livestock that is raised, especially cattle, would help slow down deforestation, as well as greenhouse gas emissions.

Other general policies that could be implemented to make agriculture more sustainable are, for example, helping less economically developed countries to become mostly self-sufficient in food production. In order to minimize food waste, there could be sales in stores for food items that are close to expiring or food donation boxes where old food could be brought and could be given to livestock.

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